## Peter Flaschel's Bielefeld School and Climate Macroeconomics: Some Proposals

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The network of economists grouped under the name "Bielefeld school" (of macroeconomics), with Peter Flschel having been one of the 'master-minds', have developed and tried several approaches to macroeconomic modeling, one evolutionary line being the KMG-models (Keynes-Metzler-Goodwin), and another being the MKS-models (Marx-Keynes-Schumpeter).

Not surprisingly there are as a consequence several opportunities to connect Climate Macroeconomics consideration to these 'buildings' of the "Bielefeld School". Some of them which come to my mind I shall present in a purely verbal and more or less 'untechnical' way below. So this is not a 'scientific paper', lacking e.g. rigor, jargon and mathematics.

A. The issue of 'Climate Change' (which really is an impending catastrophe) is important as mainstream economics which is dominated by neoclassical or new-neoclassical thinking has not much to offer. Loosely speaking it presents plain nonsense (e.g. its equilibrium thinking), complicated nonsense (e.g. its jump variable technique) and wicked nonsense (e.g. Nordhaus' DICE-models, e.g. [Nordhaus 2008, Nordhaus 2013]). In consequence it is very difficult to judge which results of this school are reasonable or trustworthy.

And the issue is utmost urgent, as the following figure [Weitzman 2015, p.53] shows.

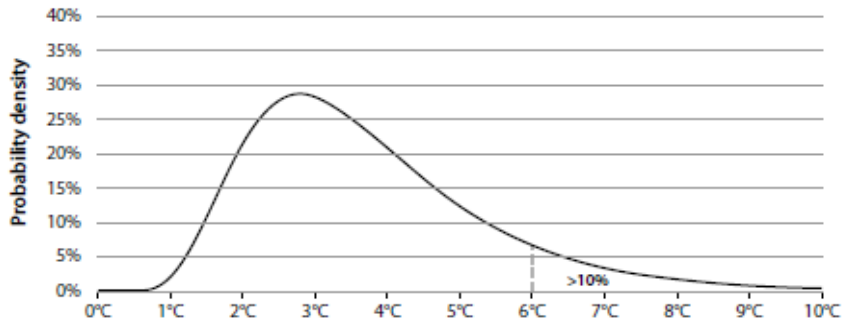


Figure 3.2 **Eventual global average surface warming based on passing 700 ppm $CO_2e$**

A level of 700 ppm means a 'most probable' temperature increase of about 2.7°C, which may not arouse the mind of many.
But because of the "fat tail"[3] it has a >10% probability of an increase of +6°C (or more !!). And this is really frightening: +4.5°C mean -40% usable area for life on earth and +5.5°C mean 60 deadly days per year in the mid-altitudes of our planet (roughly 40° N to 40° S, where 74% of the world population live) [Keen 2022a, p.73].
And 10% is 'significant': no medicinal treatment would be approved by the authorities if it had severe side-effects with such a probability.

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[1] The Friede-Gard-Stiftung, founded 2020, promotes an alternative economic theory – to replace neoclassical mainstream economics - for the modeling of an economical, ecological and socially sustainable economy and society. To this end it awards annually the Friede-Gard-Preis for sustainable economics. A cooperation with the Trier University of Applied Sciences/ Umwelt-Campus Birkenfeld is established.
For more information see www.Friede-Gard-Stiftung.de and www.Umwelt-Campus.de/Friede-Gard-Preis

[2] I thank Christian Proaño for suggesting this title.

[3] Because of this neoclassical optimization techniques fail (Weitzman's Dismal Theorem)[Weitzman 2009]

To see the urgency recollect:
- 2021 saw a level of 508 ppm, rising approximately by 2,5 ppm per year [NOAA Annual GHG Index],
- what we do for the better now, will only show its effects with a lag of 10 – 20 years,
- the Stern Report judged a level of > 500 ppm as critical because anywhere from there tipping points could be triggered. (The melting of glaciers and the thawing of permafrost ground already are real.)

After this introduction now for the better (hopefully), presenting some proposals suggested by Peter Flaschel and his work.

B. Before that, as an orientation, some 'basic' questions (which hopefully can be tackled with 'basic' models, i.e. not too complicated ones) which arise in the field of climate macroeconomics - where economic advice is sought by policy makers (and a difference should be made in contrast to the appalling [Keen 2020] recipes of mainstream neoclassical economics):
- The developed economies (Europe, North America) live well beyond a sustainable ecological foot print and are under pressure to reduce it; China and India and others want to 'catch up' with further high growth rates – how can we model a situation with degrowth in one part and growth in another part of the world, to find a 'track to sustainability' and avoid all lurking pitfalls?
- At the end of this 'catch-up' it is highly probable that the global ecological foot print is far from sustainability – how can we then 'downsize' globally?
-How far is 'decoupling' of growth (of output, of welfare, of well-being, of happiness, or of what?) from material (and energy) input possible? (Or at least 'decarbonization', thereby avoiding further stress at least on the climate system.)
- How can economies which invest into 'greening' of their industries compete with other economies who work without these costs? (Concepts of cross-border taxation according to ecological standards are in the political arena – can non-neoclassical economists make advice that makes a difference?)

For the 'model-builders' it may be of interest to take 'a look outside their box':
- From a practical point of view it is relatively straightforward what needs to be done (at least) to first reduce (and finally avoid) GHG (greenhouse gas) emissions to 'save our climate': less fueled cars, ships, airplanes; less fueled power plants; less cattle (meat in the diet); less deforestation [4] – how can we cover this in macroeconomic models? [5] (From a system dynamics perspective this is more easily done, as e.g. the work of Meadows [Meadows 1972] has shown.)
- The task of the modeler should be to build his model according to the 'as is'-situation, but then also to allow for introducing rules and restrictions to reflect a 'to be'-design without the unwanted 'side-effects' of the 'as is'-situation (as e.g. done – at least in theory – by the German Ordo-Liberalism).
- Can the old ideas of Silvio Gesell[6] be of help – and how to model them? Or those of Henry George[7] ?
- 2022 is the 50th anniversary of "Limits to Growth" – how can we do better to-day[8] ?

[4] Of course this does not include other huge problem areas: biodiversity (species extinction); plastic and other garbage, pollution of air, water and soil by pesticides etc.; supply of drinking water and water for farming at risk; etc.
[5] Maybe this is not possible without some sectoral view (as in input-output models), so to say meso-economics
[6] Free-money/ 'rusting money' and free-land
[7] Georgian single tax
[8] The 'Meadows-model' only rudimentarily covered economics, and especially did not include prices and monetary issues – which certainly are 'missing ingredients' since we know from empirics (e.g. the global crash of 2007/ 2008) and from theoretical work (e.g. of Peter Flaschel himself) that the financial sector, e.g. bond market [Flaschel 2020, p. 34]) can easily be a source for instability of the whole system (saddle point instability).

C.1 The first proposal really was suggested by Peter Flaschel himself in two of several telephone conversations which I had in preparation of the details of the awarding ceremony for the Friede-Gard-Preis 2021. It is a 'corollary' of his (and others) work on input-output models (done around the 1990's). If one sector innovates (with respect to labor or energy input per output unit), all sectors will benefit, and the overall input per product unit will be reduced (Flaschel 2018,, chapter 7][9].
Peter Flaschel presumed that this can be demonstrated for every primary factor.
This opens potentially the possibility of at least partial decoupling, i.e. possibility of growth with reduced material and/ or energy input. Some questions remain, e.g.
- what conditions have to be imposed for the results to be valid?
- what happens if not two sectors are analyzed but two different economies (e.g. Europe/ USA vs. China/ India, where the Western economies innovate whereas the less developed focus on growth)?
- what happens if in parallel to innovation both economies grow, the less developed much stronger[10]?

C.2 The second proposal also takes up a comment by Peter Flaschel, namely that the political and the economic system are so closely connected that we need to model them both and simultaneously. One way to achieve this could possibly be to introduce additional agents (not just labor and capital). I suggest to reflect anew about Quesnay's Tableau Economique (which is actually also the didactic starting point in Peter Flaschel's textbook on Keynesian macroeconomics (only published in German) [Flaschel 2012], and which John Blatt has used to formulate his dynamic analysis [Blatt 2015]), where we have – in modern terminology -
- rentiers (church, government, etc. as asset-holders, collecting a rent from their land (capital) without personal input (and normally without risk)),
- 'capital-managers' (who have to make the most out of the rented land to survive (or even prosper)),
- labor (only implicitly, as a factor which has to reproduced to do the required (mainly) manual work)
- and craftsmen (as a possibly innovating sector).
In a first approximation politics can be modeled as the system organizing the economic and social interests of these groups. (For another approach see below (C.8).)

C.3 Thirdly, staying with Peter Flaschel's last insights: he saw the MKS-model as a base model for a modern liberal, capitalistic economy [e.g. Flaschel 2009], and he thought that the Marx- and the Keynes-components were quite well done, but he was not so satisfied with the Schumpeterian part, i.e. innovation.
Weidlich, Haag and Mensch have tried to cover innovation in their long paper "The Schumpeter Clock" [Haag Weidlich Mensch 1987] by an approach coming from synergetics (see below (C.8)).
For me it seems easily possible to incorporate that in a similar fashion as Flaschel and coworkers have incorporated 'opinion/ sentiment dynamics' in their models, since one 'line of genealogy' goes back to Weidlich and Haag [Weidlich Haag 1983], even if in most economics literature it is traced back only to Lux [Lux 1995]. Haag, Weidlich and Mensch handle the situation where firms have to decide on innovation (new products to increase market share vs. or new production processes to decrease costs) depending on their opinion of the 'market perspective' and their 'attitude' (conformist to the 'herd' or non-conformist).

[9] This seems rather obvious, since when we imagine the production interdependencies as a kind of network, the 'downstream' sectors will profit from innovations done more 'upstream', and the overall gain will be the larger the more 'upstream' the innovations are done.
[10] When is the saving of resources by innovation outweighed by the growth of 'brown' production?

This model could then hopefully be used also to weigh 'green' innovations vs. 'traditional' innovations, and analyze how to support the first and hinder the second type of innovation (by political means, e.g. "Ordnungspolitik" according to Walter Eucken).

C.4 A worthwhile task could be to check how the 'Flaschel-models' behave under 'time-reversal', i.e. going the long-run growth-path 'back in time', thereby going back to situations with less material input (even if it is not explicitly contained in the model).
With a solution to this the more complicated situation of a (globally) shrinking economy in parallel with constant or rising population could hopefully be handled.
The question then poses itself which problems aside from the obvious problem of reduced employment arise and how to overcome them[11].

C.5 A major step could be done by incorporating the input of material resources and energy into the models to include the material basis of our economy into the economic models.
Often energy is brought in as a third production factor into the production function[12], in addition to labor and capital [e.g. Kümmel Ayres Lindenberger 2010].
Steve Keen has built energy into his model by making it an 'input' to capital and labor [Keen Ayres Standish 2019] (according the saying that "capital (i.e. production equipment) without energy is a sculpture, labor without energy is a corpse"). This approach is well supported by empirical data.
Furthermore Keen has also succeeded in building a small model with 'energy and material' [Keen 2022b, p. 211ff].
This would widen the perspective from issues of capital and labor also to those of energy and resources.
What this then has as consequences, e.g. in perspective to resource scarcity and stability vs. system collapse (as in the business-as-usual scenario of "Limits to Growth" [Meadows 1972]) and what so far hidden issues 'come to the surface' would have to be researched.

It would then have to be complemented by the external ecological constraints which the economic system has to obey, e.g. limit to greenhouse gases (with respect to the impending climate catastrophe – leaving aside all the other constraints relating to other ecological problems).

C.6 Steve Keen has provided also a Goodwin model [Keen 1999; Keen 2022b, p. 80 ff and p. 202ff] which with benefit could be compared to Peter Flaschel's approach (Flaschel 2000; p. 47ff].
Since Steve Keen builds on this when introducing energy and matter this could possibly also open a way to introduce energy and matter into the KMG- and MKS-models in an analogue way. (Even including Steve keen's approach to Minsky's Financial Instability Hypothesis could be researched.)

C.7 Synergetics [Haken 1983] – founded and developed by Hermann Haken (and co-workers) – has the concepts[13] to better understand the onset of instability of systems and the methods to deal with the situation after the onset of instability including the chance to 'identify' the new system state.

[11] Concerning unemployment the universal basic income (bedingungsloses Grundeinkommen BGE) could perhaps be a means to social protection and social sustainability under these conditions?
(According to Götz Werner, a major German supporter of BGE, the only relevant thing is that enough goods are produced, the appropriate distribution afterwards can be solved in some way.)
[12] To avoid the corresponding fallacies [Shaikh 1974.; Keen 2022b, p. 189ff] no Cobb-Douglas function should be used, but the Leontief form.
[13] E.g. phase transition, control parameters, order parameters, enslaving, circular causality [Haken 1983].
A very short and still sound exposition is [Argyris 2017, p. 448ff]

E.g. a system going from a stable focus by a simple bifurcation to a limit cycle (Hopf bifurcation) by 'driving' the control parameter λ 'over the border' [Haken 2004].

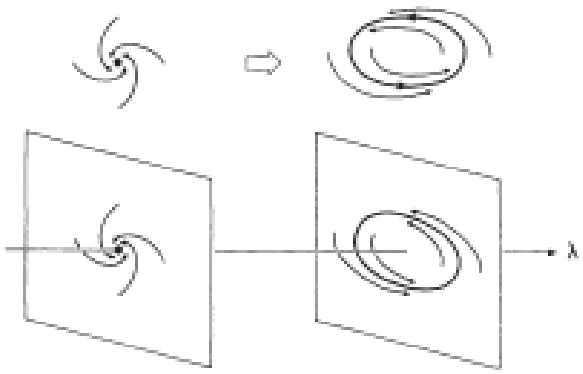
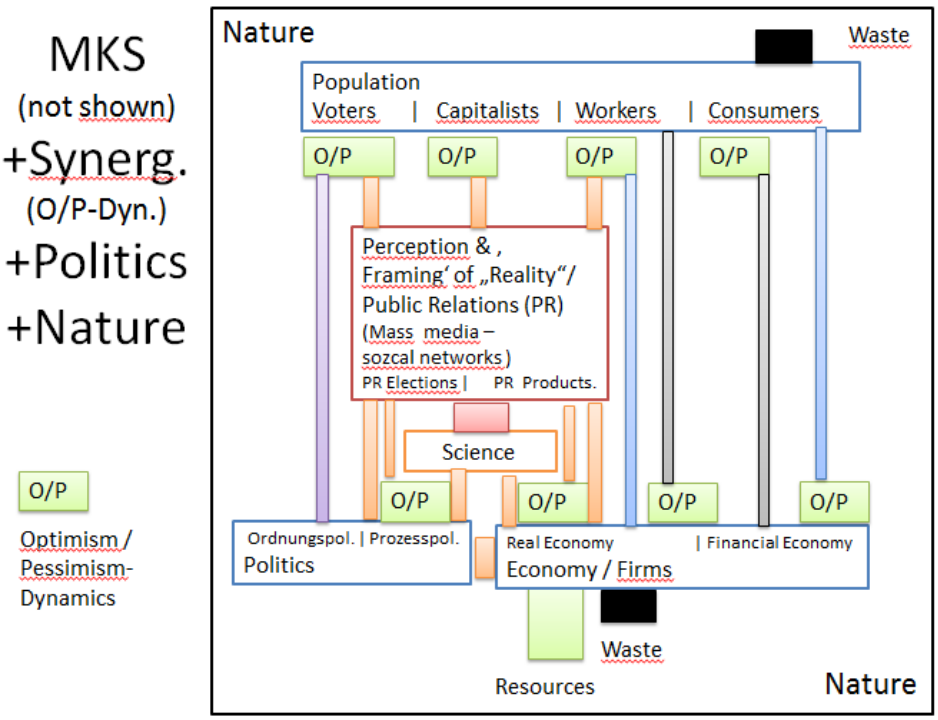



**Fig. 1.14.2.** Two ways of representing the bifurcation of a stable focus into a stable limit cycle. The representation technique is the same as in Fig. 1.14.1

C.8 Synergetics has developed in a second strain relying mainly on the so-called master equation [Weidlich Haag 1983], one focus being the evolution of sentiment and opinion dynamics.

With these models the MKS-model of Peter Flaschel could be extended to a model including the political sphere and the 'battle of perspectives', i.e. the 'fight for the framing that wins', as sketched in the following model:




Some words of explanation: 'Science' is in the center with its research of reality; it is dependent on politics and economy (e.g. money). In the 'public arena' is the battle to 'frame' reality. All the 'agents' in the system perceive the 'public arena' which affects their opinions and sentiments. Accordingly people vote, consume and behave as workers resp. capitalists. Politics and economy perceive also the 'public arena' and the actions of voters, consumers and workers resp. capitalists, and in turn try to influence them with regard to their interest. Politics and economy impose great influence on one another .The system is embedded in 'nature' and uses it as source of resources and sink for its waste.

D. The "Bielefeld School" of economics has paved the way for a better modeling of economic systems, not constrained by the fixation on an always existing equilibrium, a myth to which all mainstream-trained economists are 'bewitched'.

Some proposals have been made to expand the models so that they cover issues of climate-macroeconomics also. Further progress can be made by incorporating more of the perspective of synergetics.

The use of concepts and methods of synergetics could on top of that enhance the understanding of the dynamics of the models of the "Bielefeld School".
Recalling the threat of $CO_2$ from the introduction and looking at it from the perspective of synergetics tells us: $CO_2$ can be seen as the control parameter, its level driving the earth system at the edge of its present stability region, i.e. with the climate of the past some thousand years; further increase of $CO_2$ causes a phase transition[14] (at the so called tipping points of climate science, a term that maybe does not transmit the associated risk) into a completely different regime, with e.g. long heat-periods, massive droughts, and extreme storms and rainfalls, maybe even into a 'climate chaos' as described by the Lorenz attractor[15]. This is similar to the phase transition that water undergoes with rising temperature of solid, liquid and gaseous – regimes where very different rules apply. And unlike water where we can return to whatever phase state we want by applying the appropriate temperature, with $CO^2$ this probably will be no option: too many 'things' are irreversibly 'destroyed' during this phase transition.
Such a phase transition of the earth system will have severe impacts on the economic system, causing there similar phase transitions (probably with bigger turmoil than during the Covid-19-pandemic or the Russian war in Ukraine).

Traditionally educated economists have no idea of such things. They think of "external shocks" followed by the return to equilibrium (the old one, or an equally pleasant new one).
They could improve their imagination if they take a look into the political field. Looking back to the 1930's in Germany e.g. the proclaiming of Hitler as Chancellor of the Reich appeared to be a small and well controllable step, but what followed were phase transitions to a completely different political order and – only some years later – the beginning of a war that changed the face of the whole world (and nearly destroyed it).

The crises already present and the many more crises to come call for another economic thinking and worldview if economics wants to provide a reasonable contribution for mastering or – even better - avoiding them[16].

Hopefully some of the proposals will resonate with some reader/ listener and encourage him/ her to put his/ her research efforts on one or some of these urging issues.

[14] Or a sequence of phase transitions, i.e. one for each tipping point.
[15] This is not as farfetched as it may seem at first glance since the Lorenz equations are a simplification of the Navier-Stokes equations that describe our planetary atmosphere. (Lorenz was a meteorologist.)
[16] And even if mankind is going to master this crisis, and in future there will be energy from renewable sources in abundance, there are rather clear-cut thermodynamic limits to energy use that will 'hit our (present) way of life brutally' within some hundred years [Murphy 2021, p. 11ff]

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